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	h m 9 55+ s	Comparisons with other Observers.	
1881	36·3	36·1 1881, H. Sternberg	
		36·4 1881, G. W. Hough	
1882	37·3	37·3 1882, H. Sternberg	
1883	38·2	38·1 1883, H. Sternberg	
		38·4 1883, G. W. Hough	1883–5 38·9, Marth
1884	39·0	39·2 1884, H. Sternberg	
		38·5 1883 Sept. 12–1884 June 11, G. W. Hough	
1885	39·6	40·1 1885, H. Sternberg	
		40·4 1884 Sept. 25–1885 June 29, G. W. Hough	
1886	39·9	40·1 1886, H. Sternberg	
		40·7 1886, C. A. Young	
		39·9 1886, G. W. Hough	
1887	40·1	40·6 1887, H. Sternberg	
		40·5 1887, A. S. Williams	
1888	40·2		
1889	40·4		
1890	40·5	39·8 1890 July–December, G. W. Hough	
1891	40·6	40·7 1890 December 8–1892 January, G. W. Hough	
1892	40·8		
1893	40·9		
1894	41·0	40·9 1893 December 20–1895 January 24, G. W. Hough	
1895	41·1		
1896	41·3	41·4 1896, G. W. Hough	
1897	41·6	42·4 1897 March–May, A. S. Williams	
1898	41·9	42·4 1898 March–June, T. E. R. Phillips	

Bristol: 1898 *September* 15.

Observations of Jupiter and Jupiter's Satellites made at Mr. Crossley's Observatory, Bermerside, Halifax, during the Opposition 1897–8. By Joseph Gledhill.

This paper comprises the following subdivisions :—

1. A description of the principal features seen on the disc of *Jupiter*.
2. Transits of red spot, dark spots, &c.
3. Measures of the position of the principal dark belts and spots.
4. Measures of the bright zones, dark spots, &c.
5. Observations of phenomena of *Jupiter's* satellites.

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6. Notes on certain phenomena presented by *Jupiter's* satellites and their shadows during transit across the disc.

The observations were made with the 9-inch Cooke Equatorial Refractor (object glass, one of the new triple lenses by Messrs. T. Cooke and Sons, York) and a Simms parallel-wire micrometer. The negative eyepieces used were of powers 150 and 240; the measures were made with a power of 200. The planet was examined on every fine night from October 1897 to July 1898. On no occasion could a power higher than 240 be used. Some idea of the exceptionally bad observing conditions which prevailed during the opposition may be formed from the following statement: *a*, number of nights continuously clear throughout; *b*, good observing nights; *c*, fair; *d*, bad; *e*, sunless days.

	a	*b*	*c*	*d*	*e*
1897 October	5	1	2	5	13
November	2	0	0	6	20
December	2	0	4	12	8
1898 January	0	0	1	4	15
February	4	0	4	9	8
March	6	4	4	10	4
April	2	0	3	4	6
May	0	4	2	6	6
June	3	0	5	6	4

A DESCRIPTION OF THE PRINCIPAL BELTS, &c., SEEN ON THE DISC OF JUPITER DURING THE OPPOSITION, 1897–8. For terminology of Bands, &c., see *Measures of the Position, &c.*

Band 0 (*the S.S. Temperate Band*).

This somewhat faint grey band near the S. pole was not easily seen in all longitudes. Even when definition was good it was sometimes a difficult feature. In certain longitudes, however, it was easily seen as a broad grey band, as the following notes will show. The longitudes are from Mr. Crommelin's Ephemeris system II.

1898 March 8, $11\frac{1}{2}^h$, $\lambda = 106°$ (*i.e.* longitude of the central meridian of the apparent disc); faint and narrow. March 10, 11^h, $\lambda = 28°$; the band is faint; it is about as far S. of 1 as 1 is S. of 2. March 14, 11^h, $\lambda = 240°$; well seen. March 19, 11^h, $\lambda = 300°$; well seen. March 20, 9^h, $\lambda = 20°$; well seen; $10\frac{1}{2}^h$, $\lambda = 90°$; faint. March 21, 11^h, $\lambda = 243°$; not seen, yet 1 is a very easy feature. March 23, 9^h, $\lambda = 111°$; well seen; 10^h to 11^h, $\lambda = 148°–184°$; not seen as a belt distinctly separated from the polar shading to the S. March 30, 11^h, $\lambda = 157°$; not seen. April 5, 11^h and 12^h, $\lambda = 339°$ and $16°$; well seen. May 6, 10^h,

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$\lambda=283^\circ$; easy, a distinct band all the way across the disc. At 9^h, $\lambda=247^\circ$; a wider and darker portion of the band had reached the central meridian; and a large dark spot on it was central about $10^h\ 24^m$, $\lambda=298^\circ$. May 11, 7^h, well seen; $\lambda=206^\circ$. May 16, $8\frac{1}{2}^h$, well seen, $\lambda=291^\circ$. May 18, $10^h\ 10^m$, the dark spot was central, $\lambda=292^\circ$. At this time the band was as broad as 1, and more distant from 1 than 1 from 2. May 28, $8^h\ 20^m$, $\lambda=288^\circ$; faint. June 28, $8\frac{1}{2}^h$ to 9^h, $\lambda=269^\circ$ to 287°; well seen, a little darker and broader than 1.

So that it appears to have been well seen in longitudes of central meridian 16° to 28°, 200° to 250°, and 270° to 340°; and very faint in about 90° to 110°, and 140° to 180°.

Band 1 (*the S. Temperate Band*).

This band was always visible, sometimes quite narrow and faint, at others quite a prominent feature. Its general appearance was that of a strap-like, grey band; but in some longitudes its S. edge was a sinuous line.

1897 October 21, 6 A.M., well seen all across the disc. 1898 February 16, $12\frac{1}{2}^h$, $\lambda=15^\circ$; faint. February 18, 11^h, $\lambda=261^\circ$; faint. February 21, 10^h to 12^h, $\lambda=316^\circ$ to 28°; very faint. February 22, 12^h, $\lambda=180^\circ$, faint; and on the 24th at 11^h, $\lambda=83^\circ$, and the 27th at 12^h, $\lambda=211^\circ$. March 2, 10^h, $\lambda=230^\circ$; well seen. March 3, 12^h, $\lambda=92^\circ$; faint; and on the 6th at 10^h, $\lambda=110^\circ$; but at 12^h it began to widen a little to the east of the central meridian, say when $\lambda=184^\circ$. March 7, 12^h, $\lambda=334^\circ$; well seen; also at 11^h on the 10th, $\lambda=29^\circ$. March 12, 10^h faint; $\lambda=293^\circ$. March 14, 10^h, $\lambda=234^\circ$; well seen, it ranks next to 2, 3, and 4 in prominence. March 19, 11^h, $\lambda=303^\circ$; well seen. March 20, 9^h, $\lambda=21^\circ$; well seen; so also on the 21st at 10^h, $\lambda=207^\circ$. Passing over a good many similar observations the following may be given as times when the band was very faint: February 21, as above; also May 12, 7^h and 8^h, $\lambda=356^\circ$ and 33°, very faint and narrow; so also on May 18, 9^h, $\lambda=250^\circ$. The sinuous appearance of the S. edge was well seen on May 14, at 8°, $\lambda=315^\circ$ and the band was faint. On April 12, 7^h to 10^h, $\lambda=167^\circ$ to 276°; the band was well seen, and at 8^h, $\lambda=203^\circ$, it was nearly as wide as zone *b*. The sudden widening of the band was seen on March 6 as above, and also on May 3, May 6, May 8, May 12, and June 27.

Band 2 (*the S. Component of the S. Equatorial Belt*).

There has probably been very little change in the appearance of this band since the last opposition. The two shoulders are still very marked features in it, and so are its disappearance between the shoulders and its sudden change of depth of tone in a certain longitude. The following notes give all the most noticeable observations:—

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It was seen narrower than 3 on February 8, 13^h, $\lambda = 269°$, and not so dark; also on February 16, 12^h, March 6, 10^h, March 30, 11^h; as dark and broad as 3 on March 20, 11^h, March 23, 9^h, May 15, 8^h, May 16, 7^h, May 18, 8½^h. On March 7, 12^h, it appeared broken up into dark portions, or had dark forms on it. Its S. edge was irregular in outline on March 20, 11^h, and on March 23, at 8½^h. The darkest and most striking portion of the band is at the *f* shoulder; and at this place too a kind of tuft or wisp was often seen projecting into the bright zone to the south. The other noteworthy feature is its sudden change in depth of tone and in width; when this point was seen near the W. limb (*i.e.* passing off the disc) it was known that the *p* and *f* shoulders would soon be seen at the E. limb. When the red spot was on the central meridian the faint and narrower portion of 2 extended quite to the *p* limb.

Band 3 (*the N. Component of the S. Equatorial Belt*).

Of all the dark bands seen on the disc of *Jupiter* during this opposition this has been in many respects the most interesting. Its S. edge has often presented a fairly uniform and undisturbed outline; it has been dark and broad in all longitudes—indeed, the darkest and broadest band on the disc—and the dark oblong spots on, or detached portions of, this band, the bright gaps between them, the apparent shift of some portions to a more northern latitude, and the draggling down (to N.) of cloudy matter or form into the central zone, have formed very interesting objects of observation. A few notes selected from a large number will show the general character of these phenomena :—

1897 October 21, 6 A.M., the band was broken up into detached dark portions. 1898 February 8, some of the dark forms project into the central zone; so also on February 16 and February 18. On February 21, 13^h, three dark elongated portions of the band lay under and in contact with the N. edge of the band. February 22, 11^h to 12^h, a gap or break was seen in 3, followed by a dark spot on it; and just to the east of the spot the band became darker all the way to the *f* limb of the planet. Bright gaps and dark spots, or detached short portions of the band, were also seen on February 23, 11^h; February 24, 11^h and 12½^h; February 27, 12^h; March 2, 13^h, and many other nights. Sometimes, as on March 6, 10^h, the whole band was a series of six or more dark portions with bright spaces between them. These detached oblong portions were occasionally seen slightly inclined to the general direction of the band, as on March 10 at 11^h. There was a dark spot or protuberance just under (to N. of) the *p* shoulder on June 12, 8½^h, and it projected into the central zone. This was often seen. A similar form was seen just under, or a trifle behind (to E.), the *f* shoulder, *e.g.* May 14, 7½^h. On May 16, 8½^h, the whole band consisted of three detached portions.

Bands 2 and 3 lay very close together, leaving but a very narrow bright zone between them, except when 2 became suddenly pale, grey, and narrower, *i.e.* a few hours before the red spot reached the central meridian.

Band 4 (*the N. Equatorial Belt*).

This prominent band (double during the opposition of 1896–7, but single during that of 1897–8) was quite as much broken up as band 3. Its south edge was in most longitudes ill defined. The following notes will give a good idea of the phenomena presented by this band during a rotation of the planet :—

1897 October 21, 6 A.M., as dark and broad as 3 and more broken up, the S. edge being a series of projecting forms, the N. edge a smooth line. 1898 February 18, 11^h, as dark as 2 or 3. February 24, 11^h, seems double. February 27, 12^h, a fairly uniform band. March 6, 10^h, not nearly so broad as 3 ; so also at 12^h. March 12, 10^h, nearly as dark and broad as 3. March 20, 9^h, as wide and dark as 3, and broken up. March 21, 13^h, very broad and dark. March 24, 9^h, as on March 20 ; same on March 30, 11^h. April 4, 9$\frac{1}{2}^h$, narrow and dark. April 12, 7^h, as on February 18. May 4, 10^h, narrow and dark ; N. edge sharp ; S. edge indefinite. May 12, 8^h, narrow ; 11^h, not so dark as 3. It was dark and broad on May 15, 7$\frac{1}{2}^h$; May 16, 7^h ; and May 27, 10^h ; narrow on June 22, 10$\frac{1}{2}^h$.

Band 5 (*the N. Temperate Band*).

This band was nearly always faint, sometimes very faint, and perhaps altogether absent in some longitudes. Its width was not the same in all longitudes. To give its appearance as 'faint,' 'very faint,' 'much fainter than 1' on the thirty to forty nights on which it was examined would serve no useful purpose here. 1898 February 22, 11^h, an elongated dark spot was seen on band 5, a faint narrow band ; this faint band was seen again at 10^h, March 6. March 10, 11^h, the band is very faint, and is a little more distant from 4 than 1 is from 2 ; it is a mere line. March 23, 9^h, distance of 5 from 4 equals that of 5 from 6 ; at 9$\frac{1}{2}$, distance of 5 from 6 is less than that of 4 to 5. At 10^h and 11^h band 5 was broad and well seen. June 27, 8^h, in the same longitude as the *f* end of the dark spot *a*, but a little to the N., appeared a similar narrow spot, probably forming part of band 5, which was seen as a narrow band to the east, but not to the west, of the spot. This was seen again on June 27, about 8^h, and on a later date. With good definition it would, no doubt, have been seen every time spot *a* came near the central meridian.

Band 6 (*the N.N. Temperate Band*).

The following notes contain a summary of all that was seen of this faint band : 1898 March 10, 11^h, it was darker and broader

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than 1, and much darker and broader than 5. March 14, 10^h, darker than 5: its darkest part was on the central meridian, about $10^h\ 45^m$. The band was very faint on 19 March at 11^h, and on the 20th at 9^h; but at $10\frac{1}{2}^h$ on the latter day it was broad and dark, as on 10 March. It was faint or very faint on March 30, 11^h, April 4, $9\frac{1}{2}^h$, May 3, 11^h, and May 12, 8^h; on May 6, 10^h, it was seen as a mere grey line. At $8\frac{1}{4}^h$ on June 22 the *p* end of a darker portion of the band was on the central meridian; this darker eastern portion was as broad and dark as 1.

The Bright Zones b (S. Tropical) and d (N. Tropical).

These two zones were always the brightest portions of the disc, and *b* was perhaps always brighter than *d* on the more than forty nights of observation.

The Central Zone (Equatorial Zone).

This zone was always of a warm yellow or ruddy colour, and was often mottled, but it was found impossible to see clearly the forms of the markings. In its northern part, near the dark band 4, a faint discontinuous band was occasionally seen: *e.g.* on 1898 March 20, at $10\frac{1}{2}^h$, two portions of this band were seen; also at 13^h on February 21, and at $7\frac{1}{2}^h$ on May 14.

The Polar Regions.

During the moments of best definition on good nights the shading in these regions could be seen to consist of fine lines or bands for a considerable part of the distance between 0 and 6 and the poles. The principal facts that appear from the observations are: (1) the region *a* was probably brighter than *e* in all longitudes; (2) the shading in *e* was always (at any rate ofter May 3) much less distinct than that in *a*: this difference was quite marked on several occasions. When the lines in *a* were well seen all was hazy and indistinct in *e*. (3) The region *a* was occasionally bluish, while that of *e* was yellowish.

The following are the observations:—1898 February 20, March 10, 12^h, March 31, 9^h to 10^h, May 3, $8\frac{1}{2}^h$, May 4, 7^h, May 8, 9^h, May 16, 7^h, May 18, 7^h, the shading in *a* was brighter than that in *e*. On March 12, 10^h, March 20, 9^h, March 21, 9^h, *a* was much brighter than *e*. On May 3, $8\frac{1}{2}^h$, the S. edge of *e* was dark or formed by a narrow dark band. On May 4, 10^h, the shading in *a* was seen broken up into fine grey bands, while that in *e* was quite indistinct. May 11, 7^h, *e* had a dark S. edge. May 12, 8^h, *a* distinct, *e* indistinct or cloudy; but at $10\frac{1}{2}^h$ both were equally definite and bright. On May 6 at 8^h *a* was for once darker than *e*. It is probable that the low altitude of the planet would account for some differences of colour, such as, for example, that contained in the observation on May 6 at $9\frac{1}{2}^h$,

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"the S. polar region is bright and white, while all to the N. of band 4 is yellowish."

From the foregoing notes it will be seen that the salient features visible on the disc of Jupiter during this opposition were as follows: the double dark band 2, 3 just S. of the equator; the single dark band 4 just N. of the equator, the coloured central zone, and the grey band 1. On fine nights, and almost in all longitudes, the faint bands 0, 5, and 6 could be seen; and in certain longitudes portions of a narrow band were seen in the northern part of the central zone. Of course, too, on fine nights the irregularities—gaps, protuberances, &c.—on bands 2, 3, and 4, in certain longitudes, were also very striking features. Lastly, three dark grey elongated spots were easy objects on good nights. Of bright circular spots few were seen, owing partly, no doubt, to the low altitude of the planet and the marked absence of nights of really fine definition. A few small bright circular spots were seen between bands 2 and 3, on the S. edge of band 0, and between bands 4 and 5.

Transits of the Red Spot, the Shoulders, Dark Spots, &c.

The Red Spot.

This object was difficult throughout the opposition. It was distinctly seen on but one or two occasions. The *f* end was often glimpsed. No trace of warm colour was ever seen within its outline. It will be obvious, therefore, that no great accuracy can be claimed for the times of its transit over the central meridian of the apparent disc.

1898.	h m	°	1898.	h m	°
Apr. 5	12 13	24	June 10	6 48	24
8	9 42	23	12	8 25	24
May 4	11 10	25	14	10 3	23
12	7 46	24	17	7 37	26
14	9 24	24	24	8 25	25
28	11 0	25	July 11	7 30	24
31	8 30	25	13	9 10	24

The p Shoulder.

This is not a very definite point: it is the point where the band 2 begins to bend down to band 3.

1898.	h m	°	1898.	h m	°
Apr. 5	11 46	7	May 31	8 0	7
8	9 14	6	June 9	10 25	6
10	10 56	9	12	8 0	9
May 4	10 40	7	14	9 35	6
12	7 20	8	17	7 7	7
14	8 56	7			

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The f Shoulder.

1898.	h	m	°	1898.	h	m	°
Feb. 21	12	20	40	Apr. 8	10	5	37
23	13	55	39	10	11	46	39
Mar. 3	10	33	40	May 4	11	35	37
10	11	15	38	12	8	12	40
12	12	55	39	14	9	50	39
14	14	31	38	31	8	58	42
17	12	3	40	June 10	7	15	41
19	13	40	39	12	8	55	42
20	9	34	41	14	10	30	40
22	11	10	40	17	8	5	42
25	8	24	39	22	7	15	43
Apr. 5	12	35	37	24	8	55	43

Dark Spot a.

This was seen on Feb. 22 for the first time and under very bad atmospheric conditions; it was not nearly so dark as band 4, close to the N. edge of which it lay; it was on a very fine band. This fine band was again seen on March 6 at 10^h. On March 8 the spot was seen to be just out of contact with band 4. It was seen to be broadest and darkest at its western, *i.e.* preceding, end on March 10 at 13^h.

1898.	h	m	°	1898.	h	m	°
Feb. 22	10	40	130	May 12	10	10	111
Mar. 2	17	14	132	15	7	42	112
6	10	35	132	31	10	46	107
8	12	10	130	June 5	9	52	105
10	13	49	131	10	9	0	105
12	15	27	131	15	8	10	105
15	12	57	132	17	9	45	103
18	10	25	131	22	9	0	106
20	12	2	131	27	8	10	107
23	9	35	133	July 9	7	50	96
25	10	58	132	11	9	25	93
30	10	17	131	16	8	35	93

Dark Spot b.

This was a small faint spot, not in contact with dark band 4, just to N. of it, and about 1″ in length.

1898.	h	m	°	1898.	h	m	°
Mar. 14	10	55	268	May 6	9	0	247
21	11	38	266	11	8	9	248
24	9	5	265	18	8	50	244
May 3	11	33	249				

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Dark Spot c.

This was a long grey spot just to the N. of dark band 4; the length, estimated, on Feb. 23 was about 3″; length to width, about 3 to 1. Its length, measured on March 31, was 4″·7 (reduced to mean distance).

1898.	h	m	°	1898.	h	m	°
Feb. 23	11	43	319	May 4	8	44	297
Mar. 2	12	25	317	6	10	12	291
7	11	32	317	11	9	15	288
12	10	34	314	16	8	28	290
14	12	9	312	18	10	0	286
17	9	39	313	28	8	20	288
19	11	17	313	June 9	8	15	287
21	12	52	311	14	7	17	283
24	10	24	313	28	8	43	277
31	10	57	306	July 10	8	35	273
Apr. 8	7	30	304	15	7	38	267
12	10	47	304				

Dark Spots on or close to N. Edge of Band 3.

1898.	h	m	°	1898.	h	m	°
Feb. 21	13	30	83	June 10	9	35	126
22	11	40	167	10	10	18	152
Mar. 2	15	57	86	14	9	35	6
7	12	0	334	15	8	35	120
10	13	42	127	17	9	45	103
12	14	10	85	17	8	47	68

Bright Gaps in Band 3.

1898.	h	m	°	1898.	h	m	°
May 6	8	5	214	May 11	8	25	257
8	9	40	212	18	8	40	238
11	7	0	206	18	10	35	308

MEASURES OF THE POSITION OF THE PRINCIPAL BELTS AND SPOTS.

The bands (or belts) and zones will be readily identified with the aid of the terminology used by the *British Astronomical Association*, viz. the S.S. Temperate band (0), the S. Temperate zone, the S. Temperate band (1), the S. Tropical zone (*b*), the S. Equatorial belt (2, 3), the Equatorial zone (*c*), the N. Equatorial belt (4), the N. Tropical zone (*d*), the N. Temperate band (5), the N. Temperate zone, the N.N. Temperate band (6), the

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N.N. Temperate zone, the S. Polar Region (*a*), the N. Polar Region (*e*).

The position of a feature of the disc was determined by measures from both limbs (N. and S.), the web through the spot, &c., being made parallel to the belts. The value of one revolution of the micrometer screw is 13″·84, and one division of the divided head is 0″·138.

As an illustration of the kind of accordance in the measures on a good night the following extract from the note-book is given :—

1898 March 31, 41″·6, 42″·2, 42″·8, 41″·9, 41″·9, 41″·9, 41″·8, 42″·8, 42″·2, 42″·3, 42″·4, 41″·9. Mean, 42″·14 ; mean difference from the mean, 0″·3.

These are from measures of the positions of belts, zones, and spots, and are the resulting polar diameters of Jupiter. Mr. Crommelin's computed value for mean noon was 42″·1.

In the following measures of the position of the belts, &c., on the disc of Jupiter no correction has been applied for the jovicentric latitude of the Earth above the equator, but all have been reduced to mean distance Δ5″·20.

The S.S. Temperate Band (o).

As this band was seldom well seen very few measures of its position were obtained. The last column gives the longitude of the central meridian at the time of observation.

1898.	″	°
Mar. 14	−11·6	240
May 11	−11·4	200

e. the measures were made when the longitude of the central meridian of the apparent disc was 240°, &c.

The S. Temperate Band (1).

1898.	″	°	1898.	″	°
Mar. 6	−7·6	130	Mar. 31	−8·1	230
10	−7·6	30		−7·7	280
14	−6·1	240	Apr. 4	−8·0	170
19	−8·8	300	12	−8·1	180
20	−7·7	90		−7·5	200
21	−7·7	210	May 6	−7·8	240
23	−7·7	150		−8·4	180
30	−7·6	160	11	−8·1	200
	−7·6	190			

Means: 1897-8, −7″·8; 1896-7, −8″·2; 1895-6, −8″·7.

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The S. Equatorial Belt (2).

This is the S. component of the double band just S. of the equator.

1898.	″	°	1898.	″	°
Mar. 6	−4·0	130	Mar. 22	−4·6	0
10	−4·7	30	23	−4·8	150
14	−4·1	240	31	−4·4	230
19	−5·0	300		−3·9	280
20	−4·0	20		−4·9	320
21	−5·9	210	Apr. 5	−5·0	260

Means: 1897–8, −4″·6; 1896–7, −5″·4; 1895–6, −5″·7.

The measures were made from the middle of the band; those in 1895–6 from the S. edge of the band.

The S. Equatorial Belt (2, 3).

The measures were made from the middle of 2, 3, or from the bright streak between them.

1898.	″	°	1898.	″	°
Mar. 14	−4·1	240	May 6	−3·2	240
31	−3·6	230	11	−3·1	200
Apr. 12	−3·3	200	18	−3·8	200

Means: 1897–8, −3″·5; 1896–7, −3″·4; 1895–6, −3″·9.

The N. Equatorial Belt (4).

(Double in 1896–7; single in 1897–8.)

1898.	″	°	1898.	″	°
Mar. 8	+4·0	90	Mar. 31	+4·6	230
10	4·5	30		3·3	280
14	3·8	240	Apr. 4	3·1	150
19	4·4	300	5	3·3	260
20	3·8	20	12	2·7	220
21	3·4	210	May 6	3·4	200
22	3·8	0		3·6	240
23	4·0	150	11	3·3	200
30	+3·2	190	18	+2·9	180

Means: 1897–8, +3″·6; 1896–7, +4″·1*; 1895–6, +2″·4.

In 1895–6 this belt was "inconspicuous in all longitudes, and was seldom well seen."

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* N. edge = 6″·0.

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The N. Temperate Band (5).

1898.	″	°	1898.	″	°
Mar. 21	+7·5	210	Apr. 4	+7·5	170
30	6·3	160	12	+7·0	200
	+6·6	190			

Means: 1897–8, +7″·0; 1895–6, −7″·4.

The N.N. Temperate Band (6).

1898.	″	°
Mar. 14	+10·1	240
20	+9·9	90

Mean: +10″·0.

The Equatorial Zone (*c*).

The measures were made from the middle of this zone to the N. and S. poles: difficult and uncertain.

1898.	″	°	1898.	″	°
Mar. 30	+0·6	160	Apr. 8	+·6	0
31	·3	230	12	·6	200
	·3	280	May 11	·7	200
Apr. 4	+·6	150	18	+0·8	200

Means: 1897–8, +0″·6; 1896–7, +0″·3.

The Middle of Zone b.

1898.	″	°	1898.	″	°
Mar. 30	−5·7	160	Apr. 4	−5·2	20
31	5·7	250	12	6·4	200
	5·9	280	May 18	−6·4	180

The mean is −5″·9.

The Middle of Zone d.

1898.	″	°
Apr. 4	+5·2	170

The Dark Spots a, b, c.

1898.	″		1898.	″	
Mar. 6	+5·7	*a*	Mar. 30	+5·6	*a*
8	5·2	*a*		5·6	*a*
14	5·2	*c*	31	4·8	*c*
19	4·7	*c*		4·8	*c*
20	5·7	*a*		5·1	*c*
21	4·7	*b*	Apr. 12	4·9	*c*
23	5·4	*a*	May 18	+4·5	*b*

Mean: 1897–8, +5″·1.

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The three spots were probably not in exactly the same latitude; at any rate the distances of their centres from the N. edge of band 4 were not quite the same.

Measures of the Breadth of Bright Zones and Dark Spots, &c.

The Equatorial Zone (*c*),

i.e. the width from the N. edge of band 3 to the S. edge of band 4. The last column gives the longitude of the central meridian at the time of observation.

1898.	″	°	1898.	″	°
Mar. 8	4·0	90	Mar. 30	3·7	160
19	3·9	300	31	3·4	230
20	3·5	110	Apr. 8	3·4	0
21	3·2	210	12	3·3	200
23	3·8	110	May 6	4·2	190
30	3·7	160			

Means: 1897–8, 3″·6; 1896–7, 3″·0.

The last column, as before, gives the longitude of the central meridian at the time of observation.

The S. Tropical Zone (*b*).

1898.	″	°	1898.	″	°
Mar. 21	2·3	240	Mar. 31	1·3	250
23	1·3	110	Apr. 12	1·2	200
30	1·7	150			

Means: 1897–8, 1″·4; 1896–7, 1″·7.

The N. Tropical Zone (*d*).

1898.	″	°
Mar. 23	1·7	110
May 6	1·8	190

Breadth of 2, 3, *the Central Zone c, and* 4,

i.e. from the S. edge of band 2 to the N. edge of band 4.

1898.	″	°	1898.	″	°
Mar. 6	9·6	130	Mar. 30	8·2	190
8	9·4	90	31	8·1	230
10	9·1	30	Apr. 4	8·1	150
19	8·3	300	8	8·2	0
20	8·3	20	12	8·0	200
	8·5	110	May 6	7·5	180
21	8·1	210		7·6	200
22	8·2	0		8·0	220
23	8·5	110	11	7·4	200
30	8·2	160			

Means: 1897–8, 8″·3; 1896–7, 10″·9.

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Breadth of 2, 3,

i.e. the double *S. equatorial belt* and the narrow bright space between them.

1898.	″	°	1898.	″	°
Mar. 6	3·6	110	Mar. 30	3·3	130
8	4·1	98	31	3·4	230
10	3·3	30	Apr. 4	3·7	140
14	4·1	250	8	3·4	20
19	3·3	300	12	3·3	203
20	3·5	20	May 6	3·8	180
21	3·6	207		3·1	151
23	3·7	120			

Means: 1897–8, 3″·5; 1896–7, 3″·8.

Breadth of the N. Equatorial Belt (4).

This band was double during the opposition 1896–7.

1898.	″	°	1898.	″	°
Mar. 8	1·3	90	Mar. 30	0·9	160
14	1·6	240	31	1·2	230
19	1·4	300	Apr. 8	1·2	320
20	1·2	110	12	1·2	203
21	1·2	210	May 6	1·6	211
23	1·2	110			

Means: 1897–8, 1″·3; 1896–7, 3″·9.

Breadth of the South Temperate Band (1).

1898.	″	°
Mar. 31	1·3	250
May 6	1·6	211

Means: 1897–8, 1″·4; 1896–7, 1″·1.

This was always a difficult band to measure; and along with the measure on March 21 is given the remark, "Width of band 1=about $\frac{1}{3}$ of width of zone *b*." On April 12 the note occurs, "8^h: 1 is nearly as wide as zone *b*;" and on May 12, 7^h to 8^h, "1 is very faint and indistinct and narrow—quite unlike its general appearance;" a wider and darker portion began to approach the central meridian about $11\frac{1}{2}^h$. On March 21, when the longitude of the central meridian was 210°, the measure was 0″·7, very different from that on May 6.

The Dark Spots.

1898. *a.* March 6. Length, 5″; distance of middle of spot from the N. edge of band 4=2″. The spot was about half an hour in passing the central meridian.

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1898. *b.* March 14. Length about 1″.

1898. *c.* March 14. Length, 3½″; time taken in passing the central meridian on March 14 and 31, about 20 minutes. A measure of the length on March 19 was 3″.

These were all difficult objects to measure, even on good nights.

OBSERVATIONS OF PHENOMENA OF *Jupiter's* SATELLITES WITH THE 9-INCH COOKE EQUATORIAL REFRACTOR.

Day of Obs. 1897.	Satellite.	Phenomenon.	Phase.	G.M.T. of Observation. h m s	G.M.T. of N. Almanac. h m s
Oct. 20	I. (*a*)	Ec. D.	Fading	17 22	17 23 35
			Just gone	17 23 27	
1898. Feb. 21	II. (*b*)	Ec. D.	Fading	12 22	12 25 27
			Bisected ?	12 24 30	
			Just gone	12 25 31	
	I. (*b*)	Ec. D.	Fading ?	14 23	14 24 14
			Bisected ?	14 24	
			Just gone ?	14 25	
23	II. (*c*)	Tr. E.	External contact	11 4	11 3
	I.	Oc. R.	External contact	11 45	11 46
Mar. 2	III. (*d*)	Tr. I.	External contact	10 6	10 10
			Bisection	10 9	
			Internal contact	10 13	
	III.	Tr. E.	Internal contact	12 22	12 33
			Bisection	12 28	
			External contact	12 33	
	III. (*d*)	Sh. E.	Internal contact	10 30	10 38
			Bisection	10 34	
			Just off	10 36 30	
	I. (*e*)	Ec. D.	Fading	10 43	10 45 50
			Bisection	10 45 30	
			Just gone	10 46 0	
	II.	Tr. I.	External contact	10 47 30	10 51
			Bisection	10 49	
			Internal contact	10 52	
	II. (*f*)	Sh. E.	Internal contact	12 14	12 18
			Just off	12 17	
	II.	Tr. E.	Internal contact	13 12	13 19
			Bisection	13 14	
			External contact	13 16	